IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Koji MASAKI
Application No.: 10/598,842
Filed: September 13, 2006
For: RUBBER COMPOSITION AND PNEUMATIC TIRE USING THE SAME
Group Art Unit: 4131
Examiner: Irina Krylova
Confirmation No.: 1122

DECLARATION UNDER 37 C.F.R. § 1.132

I, Shigeaki Matsuo, declare that:

I am a co-worker of Mr. Koji Masaki who is the inventor of the above-captioned patent application.

I received my Master of Engineering from Osaka University in 2001, and I have been employed by Bridgestone Corporation since 2001, where I have been engaged mainly in research and development of new polymers.

I have made the following experiments in order to evaluate an effect of an aromatic vinyl compound-diene compound copolymer (B) on processability, storage modulus and loss factor of a rubber composition due to a weight average molecular weight of the aromatic vinyl compound-diene compound copolymer (B).

Experimental Procedure

(Additional Example 1)

A rubber composition is prepared according to a compounding recipe shown in Table 1 by using a copolymer (B) shown in Table 2, and then vulcanized according to the production conditions of a pneumatic tire. In this example, the copolymer (B) is SBR having a weight average molecular weight of 51,000 and comprises 25 mass% of styrene and has a vinyl bond content in butadiene portion of 65 mass% as shown in Table 2. Such a SBR is included in an amount of 30 parts by mass based on 100 parts by mass of a rubber component (SBR 1500: made by JSR Corporation). Moreover, 65 parts by mass of C/B of ISAF class as a filler is used.

(Additional Example 2)

A rubber composition is prepared and cured in the same manner as in Additional Example 1 except that the weight average molecular weight of the copolymer (B) in Additional Example 1 is changed into 63,000.

(Evaluation)

With respect to the rubber compositions of Additional Examples 1-2 are evaluated the processability, storage modulus and loss factor. The results are shown in Table 2 and FIGS. 1-3. In Table 2 and FIGS. 1-3, the results disclosed in the specification of the present application are also shown, but Examples 1 and 2 in the originally filed specification is amended to Comparative Examples 7 and 8, respectively.

The processability is evaluated by an index on the basis that Comparative Example 1 disclosed in the specification of the present application is 100 by measuring a Mooney viscosity (ML_{1+4}/130°C) of the rubber composition at 130°C according to JIS K6300-1994. The smaller the index value, the better the processability.

The storage modulus and loss factor are evaluated by an index on the basis that Comparative Example 1 disclosed in the specification of the present application is 100 by measuring G' value and tan δ by means of a low heat-buildup viscoelasticity measuring apparatus (made by Rheometrix Corp.) under conditions that a temperature is 50°C and a strain is 5% and a frequency is 15 Hz.

Table 1

Compounding	parts by mass
SBR *1	100
C/B *2	65
Stearic acid	2
Zinc oxide	3
Antioxidant *3	1
Vulcanization accelerator *4	0.4
Vulcanization accelerator *5	1
Sulfur	1.75
Copolymer (B)	30

*1: SBR 1500 (made by JSR Corporation)

*2: ISAF, Seast 3H, made by Tokai Carbon Co., Ltd.

*3: Nocrac 6C

*4: Nocceler D

*5: Nocceler NS

Table 2

		Comparative Example 1	Comparative Example 2	~~Example 1~~ Comparative Example 7	~~Example 2~~ Comparative Example 8	Additional Example 1	Additional Example 2	Example 3	Example 4	Comparative Example 3
Copolymer (B)	kind St/Vi	(aromatic oil) -	SBR 25/65	SBR 25/65	SBR 25/65	SBR 25/65	SBR 25/65	SBR 25/65	SBR 25/65	SBR 25/65
	Molecular weight	-	4,000	25,000	40,000	51,000	63,000	80,000	120,000	320,000
Processability	ML1+4 (index)	100	85	87	90	92	94	97	102	130
Storage modulus	G' (index)	100	97	107	113	115	117	118	125	118
Loss factor	tan δ (index)	100	98	95	90	84	85	82	77	78

FIG. 1

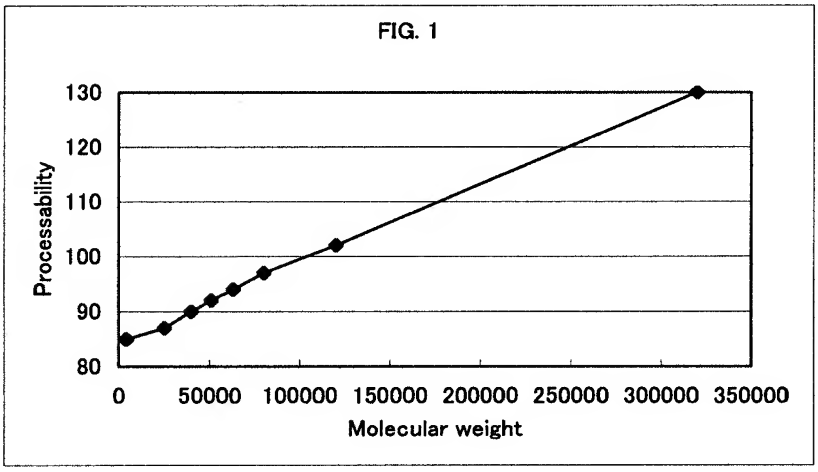


FIG. 2

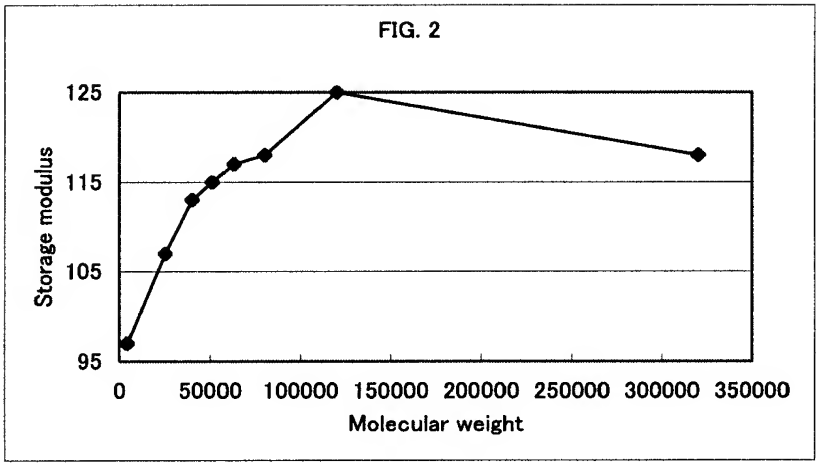
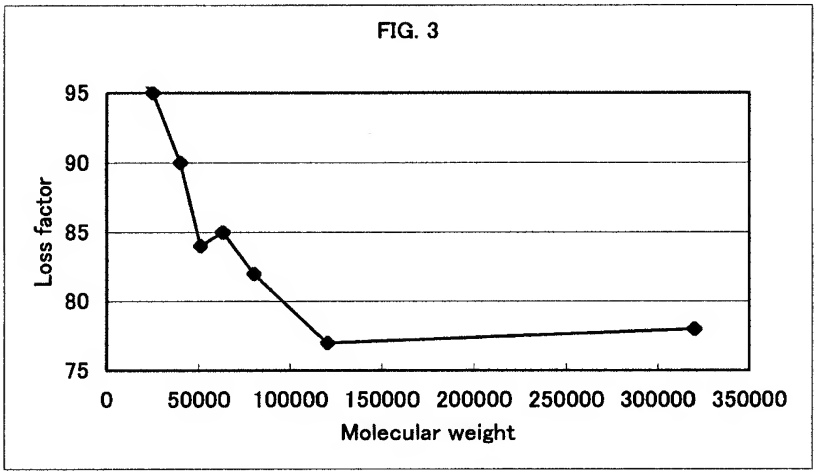


FIG. 3



(Summary)

As seen from Table 2, the rubber compositions of Additional Examples 1-2 and Examples 3-4 comprising the copolymer (B) having a weight average molecular weight of more than 50,000 but not more than 300,000 can improve the storage modulus (G') and decrease the loss factor (tan δ) as compared with the rubber compositions of Comparative Examples 2 and 7-8 comprising the copolymer (B) having a weight average molecular weight of not more than 50,000.

Further as seen from Table 2, the rubber compositions of Additional Examples 1-2 and Examples 3-4 comprising the copolymer (B) having a weight average molecular weight of more than 50,000 but not more than 300,000 can improve the processability (i.e., can lower the Mooney viscosity) as compared with the rubber compositions of Comparative Example 3 comprising the copolymer (B) having a weight average molecular weight of more than 300,000.

As seen from these results, it is confirmed that the rubber compositions comprising the aromatic vinyl compound-diene compound copolymer (B) having a weight average molecular weight of more than 50,000 but not more than 300,000 can improve the processability and the storage modulus, and can also decrease the loss factor of the rubber composition.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 3/12/09 Declarant: Shigeaki Matsuo

Shigeaki Matsuo